THE TELEGRAPHIC JOURNAL.
VOL V.—No. 103.

TYPE-PRINTING TELEGRAPHS.

THE invention of a type-printing telegraph instrument was a favourite problem even in the early days of electric telegraphy. The idea followed as a necessary consequence from the invention of the step by step A B C dial instrument, but it is only within the last few years that any considerable attempt has been made to introduce a really practical form of instrument.

It was evident that, as soon as the possibility of causing a pointer to rotate step by step round a dial on which the letters of the alphabet were engraved was proved, the problem was in a fair way to be solved. The substitution of a wheel, around the periphery of which were engraved the letters of the alphabet, for the pointer was an obvious first step to take; the next was to devise some method by which a paper strip passing close to this type-wheel could be pressed against it when the letter which it was required to print came opposite the paper. Various methods were designed for effecting this necessary movement. The rotation of the type-wheel caused a vibrating spring to be held away from a contact, which spring, on the cessation of the movement of the wheel, came against the contact, thereby closing the circuit of a local battery, which caused the armature of an electro-magnet to effect the pressing of the paper against the wheel. This arrangement answered fairly well, but was open to the objection that it necessitated a certain speed at which the wheel should turn, a lower speed causing the contact to be made by the spring when not required, and consequently letters to be printed which were not wanted. Other arrangements effected the same object by reversing the working current, the step by step motion of the type-wheel being effected by the making and breaking of a current of one polarity. A still better and more refined method was that of causing the step by step motion of the type-wheel to be produced by reversed currents acting on a polarised armature; these same currents passed through an ordinary unpolarised magnet, which had an armature connected to the printing apparatus, and which was unaffected by the rapid reversals of the current, but which was attracted when any particular current lasted for a long interval of time.

The accomplishment of an arrangement for effecting the printing was by no means a completion of the problem, that is, the invention of a practical printing telegraph. Great defects existed which seem to have baffled telegraph mechanicians—viz., the liability of the apparatus to skip letters, and the necessity consequent thereon of an arrangement for bringing the type-wheel back to its eorrect position when this skipping ensued. This necessitated constant watching, so that the error might not run right through the message.

Professor Hughes had these defects in view when he devised his well-known type-printer, in which the necessary synchronous movements of the transmitting and receiving instruments were produced by means totally independent of the two instruments themselves, the electric current only being used to actuate the printing portion of the apparatus and to correct at the moment it was sent any slight difference which might exist between the proper positions of the transmitter and receiver. The apparatus, although it has been in considerable use, is quite unsuited for a purpose for which type-printers are eminently useful—viz., for private firms who require telegraphic communication between their places of business. For such purposes it is absolutely necessary that the apparatus should be compact, easily worked and kept in order, and particularly should be capable of receiving any signals which are transmitted with unfailing accuracy when no attention is paid to it.

The printing-telegraph system has now an extensive use in America, and also to a more limited extent in this metropolis, and its happy fate is, to a very great extent, due to the invention of an "automatic zero adjuster," which prevents an accidental skip of the type-wheel from extending the error beyond a few letters; and this invention is undoubtedly one of the greatest improvements which has been made in instruments of the kind.

Considerable attention has also been paid to the correct proportioning of the many different parts, so as to reduce their inertia to a minimum, and thereby enable a high speed of working to be obtained. The extent to which this has been carried and the ingenuity exercised in producing a perfect instrument has been seen in the Phelps' Printer, a description of which has appeared in the columns of this Journal.

The Americans have ever been in the van in introducing improvements in apparatus of the kind, and it behoves English telegraph mechanicians to make a push if they do not wish to be left in the background.

A PROTECTOR which is likely to prove of value for submarine cables has been found in the *Eucalyptus globulus*, which successfully resists the ravages of the teredo.

ON RECENTLY ADOPTED METHODS OF LANDING SHORE ENDS OF CABLES.

THE methods adopted for landing the shore ends of submarine cables have been but little touched upon in any scientific journals, and as the subject possesses points of considerable interest, particulars of the means employed in landing some of the shore ends on the West Coast of America cables will not prove out of place in this Journal.

We will take our "departure," speaking in a nautical sense, from the Port of Mollendo, where the second shore end for the Chorillos-Mollendo section was landed.

On July 22, at 8·0 a.m., the I. R. G. P. & Telegraph Works Company's steamer *Dacia* was anchored off the landing-place at 3½ cables' distance from the shore, the state of the surf being exceptionally favourable for the work in hand.

The first operation was the carrying of a light lead line from ship to shore by means of a "balsa," *i.e.*, a small raft constructed of inflated bullock-skins. To this line was attached a quantity of 3-in. Manilla rope, to the further end of which again was attached 5- and 6-in. Manilla rope. This latter being drawn on shore, the cable end was "bent on" to it, and a locomotive attached to the rope, which passed through a large "spider" sheave capable of allowing the shackles by which the ropes were connected to pass through freely, the engine running parallel with the beach and nearly at right angles to the position of the ship.

The cable, a double-armoured one, weighing 15 tons to the nautical mile, was sustained during its transit to the shore by barrels, of a carrying capacity of 384 lb. at half-immersion, at infervals of from 5 to 15 fathoms.

These barrels were fastened to the cable with a 2-in. rope rove through four rings, two on the top and two underneath (*vide* sketch), so arranged that the rope should "run" freely through all the rings, it being hitched securely to the cable after passing through the two lower rings, thereby enabling the cable to free itself from the barrel on the rope being severed between the two upper rings.

This method of floating a heavy cable ashore has many advantages over that of using boats or barges, and is equally practicable in smooth or rough weather, the barrels detaching themselves in a heavy surf from the cable in a few hours at most, even when the best Manilla hemp rope is used. There is no danger of the cable being thrown over, as from a boat or barge in a "half-turn," so as to form a kink when raised to the surface. No men are required away from the ship during the landing, excepting, of course, those detailed for shore duty; and where good power, such as can be obtained from a locomotive, is available on shore, but a slight deviation from the straight line owing to current or wind between ship and shore will take place.

Speaking of locomotives, it is certainly worthy of remark that the bold and rugged nature of the coast would seem to preclude the possibility of railways being constructed at all.

Telegraph communication must of a necessity accompany railways, and it is not too much to say that where a good and extended system of railroads exists, the want of submarine lines will make itself felt as well as of land lines. In fact, on the West Coast of America, where the establishment and maintenance of aerial or underground wires is attended with serious difficulties and impediments, owing not only to the nature of the ground and its formation being extremely unfavourable to either, but to the prejudices of an ignorant peasantry and to the frequency of local disturbances of a political character, the necessity for employing cables must be apparent.

To resume. The length of time occupied in landing the shore end at Mollendo, from the time of anchoring the ship until sufficient cable was on shore, was five hours, and in seven hours forty-eight minutes from the time of anchoring all gear and men were aboard and the ship under weigh, paying out cable towards the buoy on the deep sea end.

All this was accomplished at a place where a boat could not venture at any time through the surf, and where, for days together during the full and change of the moon, no landing could be effected at the mole, or wharf, the breakers during these periods forming in lines five and six deep, rolling in and thundering on shore with a noise like the roar of heavy artillery, causing the ground to tremble even on the heights, and the buildings to shake as from an earthquake shock; a surf that would make the boldest quail to venture through, and convert into matchwood the stoutest and most improved life-boat. The useful and buoyant "balsa" would, in these times, be of no service, their expert and usually fearless crew of two nude natives preferring to watch the angry waters from a safe "vantage" ground on *terra firma*.

At Arica, the port at which the second section terminated, the ship was anchored some three cables' lengths from the beach, and warped into position with stern to shore, a locomotive, as on the previous occasion at Mollendo, being in readiness.

The requisite ropes were landed, and the end of the cable was paid out from the ship at 10·45 a.m. At 1 p.m. there was enough cable on shore, at 2·30 p.m. all barrels, &c., were on board, and the ship under weigh, paying out to the buoy, the time occupied being *three hours and forty-five minutes*.

At 11·40 a.m. August 1, 1875, ship being in position, locomotive as before, &c., the end of cable was paid out from ship. At 1·0 *p.m.* "enough cable on shore" was signalled, and at 2·25 p.m., all barrels, &c., being on board, the ship was under weigh paying out cable—the time occupied being two hours forty-five minutes, or one hour less than on the previous occasion.

At Iquique, the termination of the third section, the shore ends were landed within the precincts of the railway company's property, and here again a locomotive was made use of. The vessel was anchored close in about 1½ cable's length from the beach. At 9·45 a.m. the hauling ashore was commenced. At 10·45 a.m. enough cable was on shore. At 11·45 a.m. anchor was up, and vessel steamed away paying out cable to buoy, two hours being occupied in the operation.

Exactly the same time was occupied in landing

the end of the fourth section from the above-named port to Caldera.

To those who have had experience in landing the ends of heavy cables the employment of locomotives, where available, will present advantages infinitely superior to all other means that have hitherto been used. The great power at hand, so easily controlled, capable of overcoming all impediments and delays so often caused by rough water, strong currents, or what not, cannot be too highly appreciated.

With thoroughly good hauling gear it would be quite practicable to land a heavy cable even without the suspension power of buoys, providing the ground be smooth and the distance from the shore be not too great, though the attachment of barrels is so simple that this need not be attempted.

Under circumstances which will prevent the barrels from being cut away from the cable, they will detach themselves in a few hours at most, and drift on shore, and if not recovered the loss would be trifling compared with that of a boat.

At Caldera the valuable aid of a locomotive was not available, owing to the landing-place being some distance removed from the railway. The method adopted was as follows :—

Two large spider-pulleys were placed on shore, secured to mushrooms buried in the ground, at a distance of about 300 yards apart. Two lengths of rope, as required, were coiled into boats; one end of one length of rope was attached to the cable at the stern pulley, the other end of the other rope was taken round a horizontal pulley at the bow, and from thence to the "picking up" drum. The boats were pulled to shore, the ends of the separate ropes rove in the two aforementioned spider-pulleys so as to meet; they were then bent on together, forming an endless rope.

When everything was in readiness the cable was paid out by means of the engine on the after drum, barrel buoys being attached as required, and cable hauled to shore by the "picking up" drum hauling in on the other part of the endless rope.

The ship was anchored about three cables' lengths from the shore at 8·0 a.m. The end of the cable left the stern at 10·20 a.m., and "sufficient on shore" was signalled at 10·55 a.m. At 11·30 a.m., all ropes and barrels, &c., being on board, ship was got under weigh, three hours thirty minutes being occupied in conducting the whole operation.

Favourable conditions are indispensable in thus landing a shore end. The distance from the beach should not exceed half a mile; a heavy surf, or a strong current setting across the line of cable, would be extremely awkward, although with good tackle, and provided that the ropes and other necessary gear could be landed, these difficulties might be overcome.

At La Serena last year, on the Peru and Chili Extension expedition, the distance of the ship from the beach and the state of the surf precluded the possibility of putting this plan into practice. Locomotives were far out of reach, so that the hauling power on shore was restricted to a number of teams of oxen, those patient but certainly stupid animals supplying the place of our former powerful friend the "iron horse."

The breakers, though not extending so far from the shore, nor forming in so many lines as at Mollendo, or that most exposed of bays, Bilbao, were exceedingly heavy. The tardy arrival of a "balsa," which had been ordered for the purpose of carrying a small line from ship to shore, caused the capsizing of a ship's boat and a severe ducking to its crew, more serious consequences being happily averted through each of the men having on a life-belt.

The intermediate type, a five-ton cable, was landed here, the bottom being exceptionally good. The ship was anchored at over half a nautical mile from the beach, and although mid-day was past before one end left the ship, both shore ends were landed before dark.

The barrels that would of necessity pass through

FIG. 1.

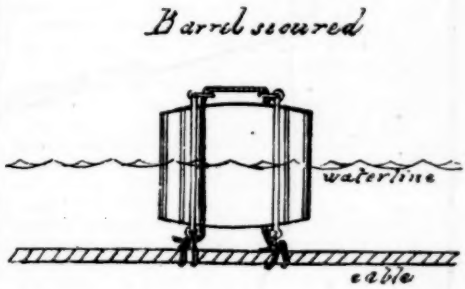
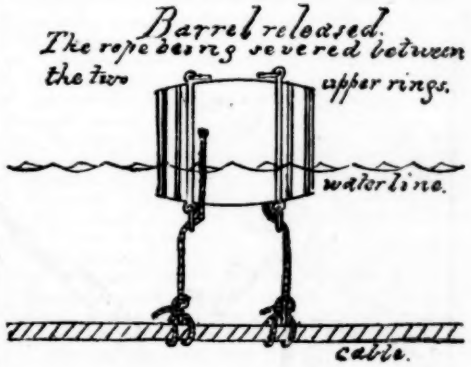


FIG. 2.



the breakers were secured to the cable with the best 2¼-in. Manilla hemp, those which could not be cut away working adrift of themselves, the rope being soon cut through by the chafing of the iron rings.

(On ordinary occasions, with smooth water, a common jute rope, specially made, is used to fasten the barrels on the cable.)

It may here be remarked that on the occasion of landing the shore end for the direct Spanish cable at Bilbao Bay in December, 1872, forty teams of oxen were employed to haul the cable on shore, the ship being anchored three-quarters of a mile from the beach.

At this time also the mode of floating the cable

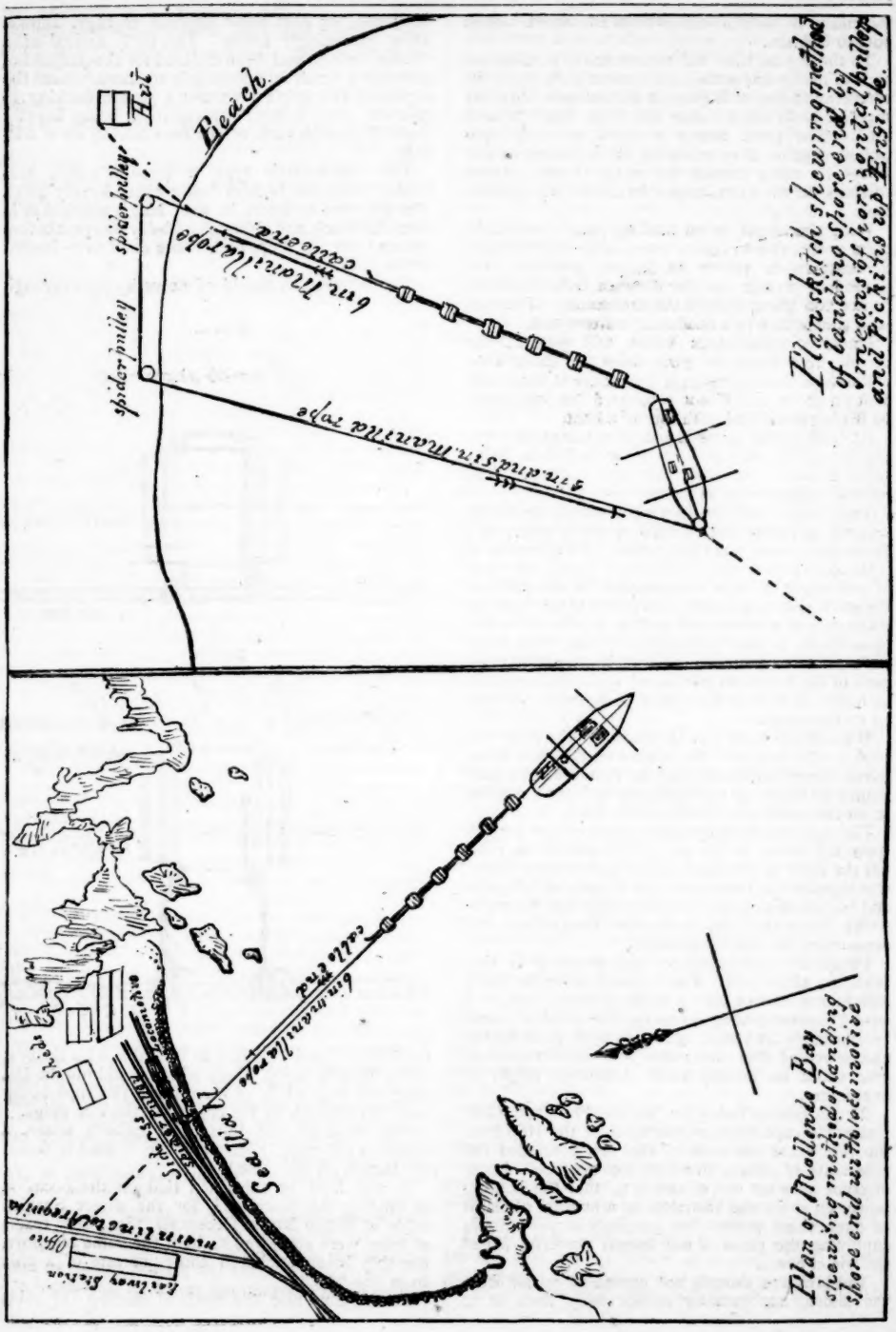

Beach.
Hut
spider-jolley
spider-jolley
6m. Manilla rope
cocoa-nut
9m. coir Manilla rope
Plan sketch shewing method of landing shore end by means of horizontal pulleys and Picketing up Engine.
Sea View
6m. Manilla rope
cable end
Plan of Mollendo Bay shewing method of landing shore end with locomotive

FIG. 3.

by means of barrels was introduced, inflated india-rubber pontoons of great capacity, and small iron buoys being used in conjunction with the same.

Experience has shown the employment of horses to be much preferable to that of oxen where powerful animals can be obtained, four stout English cart-horses in two relays being quite sufficient to haul a cable end to shore when buoyed with the barrels.

As work of a particular and novel description—such as that of submarine cable laying—progresses, so do improvements introduce themselves, these being engendered by constant practice, verifying the adage of "necessity being the mother of invention."

It is to be hoped that in the work which has been described a step nearer has been made towards perfecting the means and appliances for accomplishing that part of submarine telegraph work on the success of which depends the furtherance of the work and completion of the undertaking in hand.

UNDERGROUND TELEGRAPH BETWEEN BERLIN AND HALLE-ON-SALLE.

IN the summer of 1875 the Administration of Imperial Telegraphs of Germany decided upon laying an experimental line of underground wire, and for this purpose selected the route between Berlin and Halle.

The experience of the administration had already shown quite conclusively that the only form proper for an experimental cable was that in which the conductor is insulated with gutta-percha, and the whole core protected from outside dangers by a covering of iron wires.

The question as to what should be the diameter of the conductor and thickness of the insulating substance was referred to a committee of telegraph men who met in the spring of 1875, but did not come to any definite conclusion until after they had consulted several English electricians who were familiar with the subject.

The administration then concluded to place the work in the hands of the contractors, Messrs. Felton and Guilleaume, of Cologne on the Rhine, so that the manufacture of the cable might begin at once.

The following are the principal specifications of the contract: The cable was to contain seven conductors; each conductor to be composed of a strand of seven copper wires of one-forty-second of an inch in diameter. The lengths in which it was to be delivered to be 848 yards.

The strands were to be covered with two layers of gutta-percha and two of Chatterton's compound; one layer of the compound between the conductor and first layer of gutta-percha, and one between the two layers of gutta-percha. The diameter of the single insulated core was to be one-fifth of an inch, and that of the seven conductors with their external covering of hemp two-thirds of an inch. Sixteen galvanised iron wires of one-sixth of an inch diameter were to be used for the armour, and the windings around the cores to make one full turn in nine or ten inches.

The electrical specifications were as follows: The copper resistance not to exceed 10·5, and the insulation resistance not to be under 500,000,000 Siemens' units per 1,094 yards, at 15° C.

The contract also provided for surrounding the cable with a bituminous layer of condensed coal tar after it had been placed in the trench; and three and a half months were allowed for completing the work, which was to begin early in March, 1876. In addition to the above the contractors guaranteed the electrical condition of the entire line for one year after its completion.

The manufacture of the cable being well under way, arrangements were soon made with the department of public works, as well as with the communal and military authorities, so that the work might be commenced without hindrance as soon as the mild weather set in.

On the 13th of March ground was first broken at Halle, and the cable led into the office at that place on the same day. On the same day also a trench was begun at Hohenthurm, a village about 6¼ miles distant from Halle. This was done in order to expedite matters, the route at this place for 1,300 feet leading through a hard, rocky earth that could not be avoided. Some blasting had to be done here in opening the trench, and this being a work of a little time it was thought advisable to begin early. The rest of the route was through a light soil, which offered no special difficulties in its removal.

Beginning at Halle on March 13, on the 28th the whole line from Berlin to Halle, a distance of 106 miles, was completed.

After commencing the work it was decided to lay a second cable between Berlin and Potsdam (19 miles), and a third between Berlin and Schöneberg (3¼ miles), as a provision for the future development of the system. These were laid in at the same time the main cable was put down, arrangements having been previously made with the contractors, so that no delay would be met with in the completion of the main line.

Three squads of men were employed on the work, one for digging the trench, one for laying the cable, and the other for filling in the trench after the cable was in place.

For about nine-tenths of its length from Berlin to Halle the route lies alongside of the highway; the only places where this is not the case being in cities and villages, and the overflow districts of the rivers Mulde, between Halle and Brena, and the Elbe near Wittenberg.

At crossings where the desired depth could not be obtained, special precautions were taken to protect the cable from external dangers; and sometimes it was found necessary to make a slight detour, to avoid crossing certain bridges altogether.

This was the case at the bridge over the Elbe, and the two over the Havel. At these places the cable was covered with an additional armour of wires, each one-third of an inch in diameter, and buried in the bed of the river beneath the bridges. Where most exposed to dangers from dragging anchors it was also protected by a kind of flexible tubing of galvanised cast-iron, each section being about 20 inches long.

The same kind of tubing was also used in crossing the Landwehr Canal at Berlin, but in this case it was buried in a trench of at least 3½ feet deep, in the bottom of the canal. In a few instances the cable was laid beneath the masonry of certain structures; and where the low ground and an accumulation of water would not permit of burying it at the

proper depth, other measures had occasionally to be adopted for its protection. This, in most cases, was an iron tubing for the prevention of mechanical violence, and a surrounding of some very poor conductor of heat for rendering it less subject to the changing atmospheric influences. The woolly product obtained from the scoria of blast furnaces, and known under the name of scoria-wool, or slag-wool, has been found to answer this purpose remarkably well, and was therefore much used.

When the cable had to pass through a piece of masonry without a sufficient covering of earth, a groove six or ten inches deep and three or four inches wide was cut in the stonework. The cable was then wrapped with slag-wool and introduced in the cut and covered to the depth of an inch and a quarter with earth, after which cement was filled in and built up in the form of an arch.

In some isolated cases it was found necessary to cut the bridge arches nearly through in order to get sufficient depth. After being covered with the slag-wool the cable was then introduced in the iron tubes and the whole covered as already described.

BROWN AND ALLAN'S RELAY.

IN recording, or causing to be recorded, signals, by means of receiving instruments that make or break a local circuit, great difficulty is experienced in operating such receiving instruments when the actuating current is transmitted through a difficult or submarine circuit, on account of the armature or its equivalent of the receiving instrument not responding correctly to a slight rise and fall of potential in the actuating current. Thus, in an ordinary Siemens' relay, if the current, after moving the tongue from the insulated to the contact stop, continues to rise in potential, the armature tongue becomes pressed harder against this stop, and when the potential of the current begins to fall, from the battery being cut off, the tongue does not commence to move back and break contact until the potential of the current has reached the point at which, in the first instance, it was sufficient to bring the tongue against the contact stop. Again, when the potential of the current has fallen to a minimum, in the case of submarine cables a return wave presses the tongue of the relay against the insulated stop, and it is not free to move until the potential again falls. In Brown and Allan's relay, by a peculiar arrangement of the armature, it can be so adjusted that as soon as the potential of the working current either rises or falls the local circuit is instantly made or broken.

The method of working the armature by means of the magnetic coil does not present any distinct points of novelty, it being, in fact, but a modification of Mr. Varley's relay, the inventors no doubt being prevented by that gentleman's patent from adopting his method of working.

Fig. 1 shows a plan of one form of the relay. 1 is an electro-magnet suspended freely at its centre 2 from a bracket not shown in the drawing; 3 are terminals connected to the coil of the electro-magnet.

FIG. 1

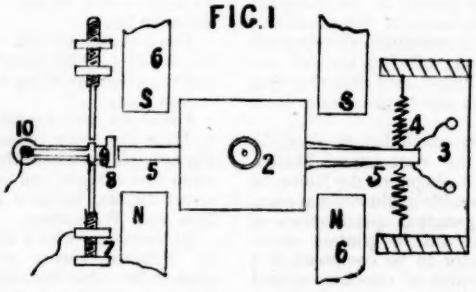
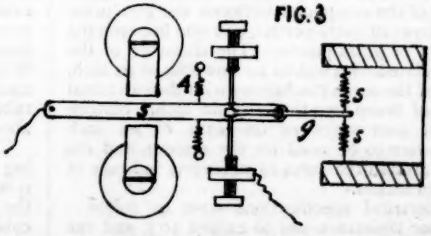


FIG. 2

FIG. 3



Two springs 4 keep the armature 5 and its coil normally in a position intermediate between the poles of the permanent magnets 6. An armature 8, pivoted at 10, so as to turn in the same plane as the armature 5, has an end contiguous to an end of the latter—so that being magnetised by induction, it follows its movements.

Moving on the same pivot 10 as armature 8 is a jockey armature 9, whose end nearest the magnetising coil plays between an insulated and a contact screw 7, as in an ordinary relay.

The pivoted end of the jockey armature moves friction-tight against armature 8, this friction being regulated by a screw *n*, fig. 2. The effect of this arrangement is that whilst the arc of vibration of the jockey armature is limited by the insulated and contact screws, the armature 8 can move through any number of degrees so as to follow the end of armature 5, but it will be seen that the moment armature 8 reverses its movement the jockey armature at once moves away from the screw it may be touching, and thus the contact of the local circuit is made or broken the moment the potential of the current rises or sinks. The great advantage of an arrangement like this, in working submarine cables, must be evident, as it enables an increased speed to be obtained.

Fig. 3 shows another arrangement of the relay. In this case, instead of the two armatures moving friction-tight to one another, the end of the jockey armature is attached to the spring s s, which allows the free movement of armature 5 after the jockey armature comes in contact with its stops, which, as we have explained, is the object aimed at by the inventors of the relay.

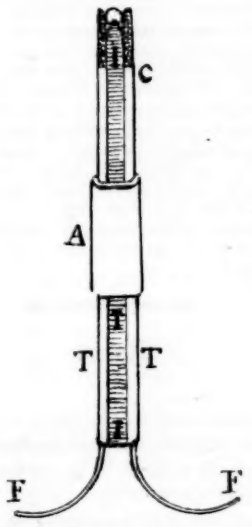
THE ELECTRIC CANDLE OF M. JABLOCHKOFF.

WE are now able to give a representation from *La Nature* of this recent invention, in which all the ordinary mechanism used for regulating electric lamps is dispensed with. In the adjoining figure, CC are the carbons placed parallel, with insulating matter IIII between them (a plate of glass, kaolin, or the like); TT are tubes of copper, in which the carbons are held; A is a case of asbestos; FF are the copper wires conveying the electric current. The voltaic arc is formed between the points of the carbons. (The little ball we shall explain presently.)

It might be supposed that the insulating plate, while separating the carbons, would ere long break and extinguish the voltaic arc by forcing it to elongate too much. But it is not so. The high temperature of the voltaic arc suffices to fuse and even vaporise the glass or kaolin, so that this is used up in the same time as the carbons.

If continuous currents be used the consumption of the carbons will be unequal, and the distance may become so great between the points that the light is extinguished. This difficulty is met by giving a double section to that carbon which is used up most quickly. But the electric candle has hitherto acted better with magneto-electric machines, giving alternating currents, than with batteries or Gramme machines. In this case the carbons are consumed equally and may have the same section. One interesting peculiarity of the candle is that the light may be put downwards, so that no part gives a shadow, and it shines on the ceiling like a star in the sky. Its brightness may be softened with diffused glasses, as with electric lights or gas.

One of the chief advantages of the candle is that you can light it at a distance. Having prepared it in the morning, say, it is only necessary in the evening to send the current to have the light instantaneously. At first M. Jablochkoff lighted his candle directly by applying to the two extremities of the "wicks" a piece of carbon, which he immediately withdrew; the arc was then obtained as in the lamps, commencing with contact and removing to a suitable distance. This does very well in experiments and various cases; but it was desirable to be able to light at a distance, and this problem has



been solved by M. Jablochkoff in a very simple way. He places between the two carbons a small piece of pencil-lead, which establishes continuity. When the current is sent, this little ball is heated, reddened, and soon consumed; the voltaic arc is then formed. Instead of the pencil-lead a fine metallic wire may be used, or a piece of metallic lead.

Again, the matter between the carbons, which insulates while solid, becomes conductive in the liquid state, and permits an elongation of the voltaic arc beyond what could be obtained in free air. This conductivity allows of opening the circuit momentarily and relighting the candle, without any of the artifices for relighting just indicated. Beyond a certain time, the cooling suppresses the conductivity, and relighting becomes impossible. The arc may

be extinguished during nearly two seconds, and lit by merely closing the circuit again. This peculiarity makes the electric candle suitable for the transmission of telegraphic signals by the Morse alphabet. A series of short or long flashes are produced, separated by eclipses of varying length. The candle is more suitable for this use than the lamp, because its relighting is quicker and more immediately complete. Indeed, the lamps come to give the voltaic arc in its normal length only gradually, whereas in the candle it has always a length superior to the thickness of the insulating plate. In optical telegraphy hitherto the Morse alphabet has also been given by flashes and eclipses; but these changes have been worked by means of screens brought before the light and withdrawn. Such mechanism is unnecessary with the Jablochkoff candle; and in an admiral's ship, *e.g.*, the signal could be read with the naked eye all round the horizon by the whole of the fleet. M. Niaudet states in his description (from which we have been quoting) that experiments in optic telegraphy on this new principle have been made in the army at Kischeneff by one of the friends of the inventor.

With the candle, provided the source have sufficient tension, several voltaic arcs may be placed in the same circuit, instead of a single light. In the halls of the Louvre lately were to be seen now four lights, now three, furnished by each of the two electric machines put in action—in all, six or eight lights. More recently MM. Denayrouze and Jablochkoff have made, as we have elsewhere stated (*Telegraphic Journal*, page 104, vol. V.), important improvements in this new system of lighting. We hope to recur to this when the invention is more fully matured.

Notes.

WE understand that the telephone is shortly to be brought to England, and that on May 24 the first tune will be transmitted by its means from Liverpool to Buckingham Palace.

THE Swiss telegraph authorities, finding that the scale of charges hitherto in force, viz., 50 cents, or 5*d.*, for every twenty words, occasions a loss of nearly 50 per cent. on the receipts and working expenses, propose that for the future the fundamental charge shall be 25, 35, or 40 cents, with a word charge of 3, 2·5, or 2 cents.

IN Turkey, 4,000 telegraph operators have struck work on account of non-payment of their wages.

THE Norwegian fishing station, Gjesvär, in 71° 12′ north latitude, is the most northerly station in the world.

M. IZZET EFFENDI, who, it may be remembered, was the delegate for Turkey to the Conferences at Rome, has been appointed Director-General of the post-offices and telegraphs of the Ottoman Empire.

A PROPOS of some new effects in electric lighting (referred to in our last), M. Planté has called attention in the French Academy to the bright light obtained when an electrode of one of his secondary batteries (a powerful one) is applied to a glass tube or wall of a glass vessel containing a saline solution. With the positive pole a stronger force is required; but the light is more silent than with the negative, which produces some crackling. When the light appears an abundant white vapour is given off, having a slight alkaline reaction. The glass is strongly attacked and devitrified. It might be thought that the brightness was due to lime combined with the silicon; but in the spectrum there are no appreciable lines, except some traces of that of sodium; whereas a piece of lime spar, under the same conditions, gives distinctly the lines of calcium, along with a continuous spectrum. The lines of silicium do not appear, being weak, and the spectrum being intensely luminous, just as the carbon lines are not perceptible in the spectrum from the voltaic arc. The silicic origin of the light is further proved by the fact that it is obtained likewise on contact of the electrode with pure silicon in the state of crystals of hyaline quartz. M. Planté proposes to distinguish this kind of light as the *electro-silicic* light.

AN improved method of performing the old experiment in which, by electric pulverisation of a gold leaf on silk or paper, an impression is obtained of images whose contours have been cut or perforated (Franklin's electric portrait), has been described by M. Barat in the *Journal de Physique*. He simply presses a glass plate on the gold leaf, and when the latter sticks he places on it the image, then paper above. When all is pressed together and the electric discharge of the battery sent through the gold leaf, the perforated contours are reproduced in purple on the paper. A second discharge must not be sent, or the glass inevitably breaks.

THE detection of metals in the tissues and humours of the body by the ordinary methods is of no little difficulty, and involves long and delicate manipulations. Two French experimenters, MM. Mayençon and Bergeret, have invented an electrolytic method, which has gained honourable mention in the French Academy. It comprises four operations: 1. Dissolution of the metallic compound by treatment with a pure acid. 2. Electrolytic fixation of the metal dissolved on the platinum wire of the voltaic battery. 3. Transformation of the fixed metal into a chloride (by exposure to chlorine vapours). 4. Characteristic colouration of a paper or even of platinum wire by a suitable reagent. This method is so sensible that

it is possible with it to detect very quickly and easily $\frac{1}{\text{8}\,\text{8}\,\text{0}\,\text{0}\,\text{0}\,\text{0}}$ of gold in a solution. Metallic compounds can be followed through the system, and the absorption, diffusion, and elimination of metallic salts studied with remarkable precision.

IN the recently published list of prizes offered by the French Academy we note that the Bordin prize (a gold medal of the value of three thousand francs) is offered for a discussion of the various formulæ which have been proposed to replace Ampère's law on the action of two elements of currents, and the reasons which may be alleged for preference of one of them. Memoirs can be sent till June 1, 1878.

MR. A. J. FROST is now engaged upon the work of arranging and editing the valuable catalogue, compiled by the late Sir Francis Ronalds, of the unique collection now in the possession of the Society of Telegraph Engineers, and of other books and pamphlets upon electricity. The catalogue contains between 13,000 and 14,000 entries, and, when completed, will be published by the Society. Sir Francis Ronalds was engaged the greater part of his lifetime in compiling this catalogue, and it will, when published, form a most valuable and interesting addition to scientific libraries.

IN the *Philosophical Magazine* for May, Dr. Kerr, of Glasgow, describes, at some length, his researches on rotation of the plane of polarisation by reflection from the pole of a magnet. In his summary he states that when plane polarised light is reflected perpendicularly from the surface of an iron electro-magnet, the plane of polarisation is turned through a small angle in a direction contrary to the nominal direction of the magnetising current. When the light is reflected obliquely, the effect in the polariscope is mixed, partly due to magnetic force, partly to metallic reflection; but in this case, as evidently as in the case of normal incidence, the action of the magnetic force is purely or chiefly photogyric, and the plane of polarisation is turned always in a direction contrary to that of the magnetising current. The rotation due to magnetisation of the mirror is impressed on the light neither effectively before incidence, nor effectively after reflection.

A QUANTITATIVE comparison between frictional and galvanic electricity in relation to tension has recently been made by a Swedish physicist, M. Nystrom. He estimates, from his experiments, that it would take more than 50,000 Merdinger elements to produce the same electric tension as may be obtained with an electrophorus.

THE reaction time in sensations of taste, or the time elapsing between the application of a savoury substance with a brush to the tongue, and the signalling of the person when he becomes conscious of it, was lately a subject of experiment with MM. Vintschgan and Hönigschnied. The contact of the pencil caused an electric circuit to be closed, and this was opened when the person made the signal. The tongue was touched, now with water, now with savoury matter, and the person, not knowing beforehand, was required to open the circuit only when the savoury matter was applied. Again, two different savoury solutions were applied, now one, now the other, and the person, on experiencing the one, had to open the circuit with one hand, and on experiencing the other, with the other hand. The time of recognition of the substances was found to be longer, the longer the reaction time.

TRAFFIC RECEIPTS.

1877.	Anglo-American Co.	Brazilian Sub. Co.	Cuba Sub. Co.	Direct Spanish Co.	Direct U.S. Co.	Eastern Co.	Eastern Ex. Co.	Gt. Northern Co.	Indo-Euro. Co.	Mediterranean Ex. Co.	Submarine Co.	West Coast America Co.	Western and Brazilian Co.	West India Co.
	£.	£.	£.	£.	£.	£.	£.	£.		£.	£.	£.	£.	£.
JAN. ...	37,780	11,469	2,311	983	13,530	42,580	24,147	12,663		... ...	9,668	2,533*b*	10,000	4,058
FEB. ...	32,330	11,606	2,214	784	15,520	35,050	19,645	12,800		... ...	8,624	2,980*c*	11,026	*3,932
MARCH ...	18,880	11,258	*2,700	913	8,110	35,491	22,886	16,115	Not published.	... ...	9,915	3,128*d*	11,643	... ...
APRIL ...	18,980	11,539	*3,500	1,011	6,930	39,861	23,068	16,151		... ...	... ...	2,362*e*	10,295	... ...

* Estimated. *b*, four weeks ending 13th January. *c*, four weeks ending 13th February. *d*, four weeks ending 10th March. *e*, four weeks ending April 7th.

City Notes.

Old Broad Street, May 14, 1877.

THE general advance in telegraph shares which has taken place since the 1st instant was, of course, anticipated. There is every reason to believe that the business of the Eastern lines will continue to increase so long as the war lasts, and the shareholders of the Eastern companies may fairly expect to benefit accordingly. We cannot quite agree with Mr. Abbott that "at such a period the question of the cost of telegraphy never enters into the minds of merchants of intelligence," for intelligent persons, whether merchants or otherwise, are generally influenced by the question of cost. But it is true that money will necessarily be spent with unusual freedom for some time to come. We freely admit that City men require to "be kept fully informed of all the constantly fluctuating changes in value." Mr. Abbott, however, avers that "the settlement of the rivalry for the Atlantic traffic came most opportunely, and the shareholders of both companies are to be congratulated on the prospect of a steadily increasing revenue, which is likely to more than compensate them for the loss of revenue by low rates during the past three months." We did not expect any other opinion from Mr. Abbott; he has throughout been a consistent supporter of the amalgamation scheme. His little crow of exultation just now is quite excusable; the time may come when he will not be able to crow. We cannot and do not wish to dispute the fact that, thus far, the Anglo-American Company has distinctly benefited by the restoration of the three-shilling rate; if, however, we grant that, for the moment, the shareholders of the Direct may not suffer, we certainly are anything but clear about the prospect of a steadily increasing revenue. Mr. Abbott, like Mr. Pender, looks only at the present; we prefer to take the future into consideration. The war will not, it may be hoped, be indefinitely prolonged. Cable companies are established with the view of a perpetual existence. We are by no means sure that affairs will prosper as Mr. Abbott anticipates, even during the time of the war. Let the shareholders of the Anglo-American and the Direct bask in the sunshine while it lasts. We do not grudge them their augmented returns; but to predict that their returns will "steadily increase" betokens the presence of a mind so sanguine as to defy our comprehension. We give Mr. Abbott up.

There are possibly still people in the world who have not such an abounding faith in the generosity of the public. We do not venture to say that the scheme for reviving an attempt to establish a cable from Brest to New York will be successful; perhaps not. But there can be no doubt that if the cable should be laid the three-shilling rate which Mr. Pender has laboured so earnestly to re-impose upon the public would have to be immediately abandoned. And if the Franco-American cable remain unlaid, is there any reason why the monopolists should have the field to themselves? They will not; and many of them know that they will not. But that knowledge will not be revealed until Anglos have, by some means or other, largely changed hands.

Meanwhile, we see it has been suggested that Mr. Pender's services to submarine telegraphy "are deserving of some public recognition." We are told that "to Mr. Pender's enterprise and courage England owes it, in a great measure, that she can in these critical times communicate almost instantaneously with her most distant colonies." Until we read the extraordinary article which appears in a paper called the *Hornet* we were not aware that even Mr. Pender himself had seriously pretended his primary purpose in life was the benefit of the public. Of course, he uses big words, or he would not be where he is; but it has hitherto been generally supposed that, however willing Mr. Pender might be to advance the welfare of England and her distant colonies, his principle and perfectly justifiable purpose—even to the act of offering his personal guarantee for a quarter of a million sterling, in order that the first Atlantic cable might be established—was to make money. It is evident that a mistake has been made. Mr. Pender's connection with the Eastern companies; Mr. Pender's conception of the Globe Trust Company; Mr. Pender's scheme for amalgamating the Anglo-American and the Direct—in short, everything it has entered into the mind of Mr. Pender to imagine and pleased him to carry out must be attributed entirely to his desire to save the pockets of his countrymen. A few days ago a small party of gentlemen embarked for Greenwich for the purpose of visiting the *John Pender*, the repairing ship of the Eastern Company; they afterwards repaired to the *Seine*, which belongs to the Telegraph Construction and Maintenance Company; and ultimately, at a grand banquet which followed, Mr. Pender's health was drunk "enthusiastically." May we take it that this is—we were going to say the puff preliminary—we will say, the shadow before the coming event? Well, when it does come, we hope Mr. Pender may derive abundant pleasure from it. We believe there are persons to be met with who would send in substantial subscriptions to the Pender Testimonial Fund—if they felt sure that, after a public recognition of his services to submarine telegraphy, Mr. Pender would consent to retire from business once more.

The trumpet of the West India and Panama Company continues to be blown. At the extraordinary meeting the chairman contented himself by observing that "since the reconstruction of the company the exchange of shares had been going on satisfactorily," a statement which no one can question. Mr. Abbott—we ask his pardon for having to refer to him again—however, who seems to think that of all individuals the shareholders in the West India and Panama Company ought to be the happiest, would not allow Mr. Earle's statement to suffice. "The great idea of the reconstruction was that the tariffs were to be increased, and he asked for information as to the results of the increase." We are glad that Mr. Earle refused to be seduced. He very wisely replied that the reason why, referring to the increased tariff, they stated in their report that "Some months must elapse before reliable information as to the effect of the increase on the annual income could be obtained" was that they did not consider the first fortnight's working could be taken as a guide. They did not wish the experience of the past month to be regarded as conclusive. It subsequently transpired that the actual increase in the traffic, from the 1st to the 30th ult., had been 58 per cent. That the reconstructed company is already showing marked signs of improvement no one can deny, but calculations which may prove delusive are to be deprecated.

In moving the adoption of the report, the chairman of the Submarine Cable Trust, after observing that the Trust was in a flourishing condition, said, "However, they had receipts sufficient to pay all their coupons in full, and to carry forward £2,450 to the next account." But why that "however"? The fact that the Anglo-American Company did not pay the dividend it had been in the habit of paying is hardly sufficient explanation. Surely there was no risk of the coupons not being paid! Possibly Viscount Monck does not always choose his words carefully.

We like to hear of good reserve funds being built up. It looks like a sound policy. We therefore congratulate the shareholders of the Brazilian Submarine Company. The enterprise may not make such rapid progress as some others are supposed to be making; but the statement of accounts is encouraging, and there are companies which point to more wonderful results, but overlook the importance of a substantial reserve fund.

The report of the Great Northern Telegraph Company, of Copenhagen, does not call for any special remark. There has been a decline in the number of messages as compared with the previous year, but an increase in the receipts. The final dividend for 1876 of two shillings and ninepence per share is now payable at the company's bankers, Messrs. C. J. Hambro and Son, Old Broad Street.

There is hardly anything to be said about railways. The Manchester, Sheffield, and Lincoln does not show signs of improvement. £1,450 is a small addition to the revenue of a great company during six months, and we quite indorse the remark that there is still only a poor look-out for dividend on the deferred stock.

The movements in the market are entirely owing to speculation. We recommend *bona fide* holders of stock not to be frightened into realising. In the event of a revival of the panic they may, perhaps, be tempted to do so.

Proceedings of Societies.

THE SOCIETY OF TELEGRAPH ENGINEERS.

AT the meeting of this Society held on April 25th, the chair was taken by Mr. Latimer Clark, M.I.C.E., one of the Society's past presidents.

A paper on "Batteries" was then read by Mr. Martin F. Roberts, F.C.S., a *résumé* of which we append.

In commencing the author remarked that, although the subject of the paper was one of such extreme importance to the telegraph engineer, he had refrained from entering further in the wide field of theoretical and practical research entertained by his theme than was to be found within the precincts of the two forms in general use in England, namely, those of Daniell and Leclanché. His paper might, therefore, have been named, with greater propriety, "The Daniell and Leclanché batteries." His excuse, however, would, he hoped, be found partly in the fact that Mr. Sivewright's paper, some two years ago, had dealt with the same subject so fully and comprehensively as to leave little to be done in the same direction after the lapse of so short a time, and partly that in suffering his paper to take the name which it then bore, he did so in the hope that, during the discussion which would follow, some particulars would be elicited from gentlemen whom he knew to have lately invented new forms, and who would otherwise be prevented from mentioning them on the grounds that such information could not fall within the scope of *that paper*.

The chief point in these two batteries common to both is the porous cell, and upon its resistance to a current will depend, to some extent, the quantity of electricity which these batteries will cause to traverse a circuit of low resistance.

The measurement of its resistance, however, by immersing it in an electrolyte, so as to cause a current to pass through it between electrodes connected with the measuring apparatus and a battery, presents some difficulty, due to polarisation. The best method yet tried by the author of the paper is to prepare a modified form of Leclanché or Daniell cell, according to that for which the porous pot is intended. This is best formed by a comparatively large-sized vessel of glass, or stone, or gutta-percha, and in which is immersed at one end an ordinary porous cell, whose resistance need not be known. Within this cell is placed a solution of zinc-sulphate, and zinc plate for a Daniell, or crystals of peroxide of manganese, broken carbon, and a carbon plate for a Leclanché. Between points, about the middle of the length of each side of the outer cell, is fixed transversely a strip of wood, to which is attached either a copper plate or a zinc rod, according to the battery as before. These plates can be removed and immersed in the porous cell whose resistance is required to be known. The internal resistance of the cell formed by the whole arrangement is then measured by any of the known methods—first, with the ordinary porous cell, and afterwards with both, care being taken that the distance between the two poles of the cell remains the same in each case. The difference between the resistances found by the two measurements gives the resistance of the porous cell. After soaking for twenty-four hours, the resistance of a Daniell porous cell, of the ordinary size, and one-eighth of an inch in thickness, should not be more than two ohms, while for a Leclanché cell of the same dimensions, half that resistance should not be exceeded. The resistance of both, however, decreases when the cells in which they are placed are allowed to work.

An important consideration, and one which hitherto has not received much attention, is the influence of hard waters on the batteries in question, more especially of calcic carbonate, carbonic acid, sulphates of calcium, magnesium, and sodium, and the chloride of the latter salt. The experiments undertaken by the author in connection with this part of the subject conclusively prove that these salts all exercise a deleterious effect on the working of both the Daniell and Leclanché batteries, but that it influences the former far more powerfully than the latter; for while 50 grains of calcic carbonate to one gallon of solution produced an increase of internal resistance in the Daniell amounting to as much as 28 per cent., the effect of introducing a proportionate quantity of the salt into a Leclanché solution produces a scarcely appreciable result. The effects of most of these salts upon the Daniell cell may be obviated by the addition of sulphuric acid to the solutions which it contains. Care must be taken in so doing that the acid added must be already diluted, for if strong it will, owing to its high specific gravity, sink to the bottom of the cell, and if the battery be a trough one, may generate such heat as to perforate through or even entirely melt the marine glue, and battery faults have often been traced to this practice.

The zinc supplied to the Telegraph Department of the Post Office is of a high quality, the average percentage of pure zinc being 99·38, the remainder being impurities in the form of iron and lead, and purity in the zincs is a matter of great importance in any form of the battery, for unless the plates be amalgamated—a source of considerable inconvenience and expense when employed on a large scale—local action immediately sets in, and undue waste of material takes place.

With reference to sulphate of copper, this salt should contain as little extraneous water as possible. The amount of this quantity may be found by taking a known weight of the sample, exposing it to a temperature of from 212° to 230° Fahr., and again weighing. The difference between these weights will indicate the total amount of water in the sample, and since sulphate of copper contains 28·9 per cent. of water of

crystallisation, all beyond that proportion will be extraneous water.

The importance of employing the salt almost entirely free from sulphate of iron—an impurity with which it is almost always associated—had, the author believed, been greatly exaggerated; and although it is stated in several standard text-books on telegraphy that sulphate of copper employed in connection with this branch of science should never contain more than a mere trace of the above-mentioned impurity, I have myself never been able to discover any appreciable deleterious results attending the employment of sulphate of copper containing as much as 0·7 per cent. of ferric sulphate.

With reference to the Leclanché—the peroxide of manganese should never contain less than 80 per cent. of the pure article, and the form known as needle-manganese is the one to be employed.

The next point of importance is the resistance of the carbon plates; these should if possible be always obtained from gas retorts, as those so obtained are of a higher quality in every respect than those not so prepared.

The resistance of any plate may be measured by placing its ends in small capsules containing mercury and measuring the resistance of the carbon arc between the two. It should not exceed one ohm.

The defect mentioned in Mr. Sivewright's paper, namely, the formation of chloride of lead between the carbon and the lead top, has since been remedied by allowing the top plates to soak in melted paraffine after capping. Anomalous as it may appear, the resistance after this operation has been performed is less than before. The average resistance of eighteen plates so treated before soaking was ·555 ohms, while after the application of paraffine the average was ·440.

Attempts have been made to modify the form of Leclanché cell. One form that has been tried is a gravity arrangement, which compares favourably with that now in use; but all attempts to make a trough Leclanché battery have hitherto been only partially successful, the zincs having been made too large for the form of cell thus introduced; complicated salts soon made their appearance, and the bursting of the porous partitions soon ensued. Another and fruitful source of evil was the leakage that was after a time found to exist from cell to cell—a fault rarely met with in the Daniell. This was at first attributed to carelessness in the glueing, but it was ultimately discovered that the solution of sal-ammoniac, possessing as it does great penetrating powers, had made its way through the porous partitions, and then along the grain of the wood—a defect which has since been obviated by varnishing the edges of the porous partition.

The chemical action which takes places in this battery may seem to be a simple one, but if followed to the end a number of counter and secondary actions take place which complicate the whole. The most important action is represented by the equation—

$$Zn + 2(N H_4 Cl) + 2(Mn O_2) + C = Zn Cl_2 + 2 N H_3 + H_2 O + Mn_2 O_3 + C.$$

and this is no doubt the only one which takes place immediately after closing the circuit; but the ammonia when liberated tends to combine with the products formed, the result being oxy-chlorides and ammonia-chlorides of zinc, which require a solution of sal-ammoniac of some strength to dissolve them, and as soon as the supply of sal-ammoniac falls short they crystallise out as a white sediment. When this takes place to any considerable extent the better course to adopt is to empty out the old solution and replace it by a fresh one. The directions issued by the India-rubber and Gutta-percha Company are to add sal-ammoniac only, which is anything but an economical course, as a considerable portion of the salt which has been added is required to dissolve the precipitated salt, and is therefore unable to be consumed without again setting free the zinc compounds already mentioned.

The sal-ammoniac generally used contains a little iron, without, however, producing any bad effect. Finally, if the solution of the Leclanché cell be heated up to nearly boiling point, the internal resistance will remain extremely low—about one-third of an ohm—so long as the temperature is maintained.

The discussion was taken up by Mr. A. J. S. Adams, Mr. D. G. Fitzgerald, Mr. Rudall, and Mr. Higgins, when, after a reply from Mr. Roberts, and a vote of thanks had been passed to that gentleman for his paper, the meeting adjourned.

PHYSICAL SOCIETY—28TH APRIL, 1877.

Prof. G. C. FOSTER, President, in the chair.

MR. W. ACKROYD described some methods of studying selective absorption in relation to the doctrine of aggregation. After referring to the absorption of iodine vapour and iodine violet solutions, he showed that an analogy exists between these solutions and the aniline dyes, and a method was indicated by which the approximate size of the particles affecting light might be estimated.

Professor H. MCLEOD exhibited several forms of apparatus which he has, in conjunction with Lieutenant G. S. Clarke, R.E., arranged for determining the speed of machinery, &c., from observations made on the figures produced by combining their motion with that of a vibrating body; a description of them has already been communicated to the Royal Society. If a uniformly moving point of light be reflected from a mirror attached to a tuning fork vibrating in a plane at right angles to the motion of the point, the reflected image will appear as an ordinary single wave; and a double figure of the form of a series of figures of eight, caused by the overlapping of two waves, will be formed if a series of points of light move uniformly with such a velocity that a point passes over two intervals during an odd number of vibrations of the fork. If equidistant perforations be made in a circle on a disc which is attached to a rotating axis, and the number of vibrations of the fork be known, the form of figure reflected on to the screen will, theoretically, give the requisite data for determining the rate of rotation of the disc, and further, a slight increase or decrease in this rate causes the figure slowly to move in the same or opposite direction to the disc. If the fork make 3,600 vibrations, and the disc 100 revolutions per minute, the circle must be divided into 72 equal intervals, but for such a number as 1·101 revolutions, 71·287 intervals are needed. This fact would introduce some difficulty in preparing an apparatus for measuring the velocity of rotation so as to give the speed in whole numbers per minute; but it may be obviated by ruling convergent white lines on dark paper, and so wrapping it round a cylinder that one line is parallel to the axis, an arrangement which gives every possible sub-division of a circle between any given intervals. The figures are then observed by examining these lines through a narrow slit in a light opaque screen, attached to a tuning fork or reed vibrating in a plane parallel to the axis of the cylinder. This observing apparatus is moved parallel to that axis until the figure remains stationary, when the number of rotations is read off on a graduated scale. Conversely, if the number of rotations of the cylinder is known the period of the tuning fork can be determined.